STATEMENT OF BASIS
(for Proposed Permit Limits (New Permit))

PERMITTEE:	River Rock County Water and Sewer District
PERMIT NUMBER:	MTX000147
RECEIVING WATERS:	Class I Ground Water
FACILITY NAME:	River Rock Subdivision 265 N. River Rock Road Belgrade, MT 59714
SOURCE LOCATION:	SW 1/4 Section 3, Township 1 South, Range 4 East, Gallatin County (Attachment 1)
CONTACT:	Steve Rude, President, River Rock County Water and Sewer District
TELEPHONE:	(406)388-0613

FEE INFORMATION

Type:	Ground Water, domestic wastes
Number of Outfalls:	1
Outfall Type:	Infiltration Percolation Cells

I. PERMIT STATUS

The permittee submitted their initial MGWPCS permit application on October 6, 2003. On March 5, 2004 the Department requested that the application fee and first years annual fee be submitted. On April 8, 2004 the Department received the appropriate fees. The application was deemed complete on May 19, 2004. The public comment period for the draft permit was March 11 through April 10, 2006. The only comments received were from the permittees representative. The Department’s response to comments and the final permit were never issued at the request of the River Rock County Water and Sewer District (RRCWSD). A June 15, 2006 letter from the RRCWSD requested that issuance of the final permit be delayed while the RRCWSD worked on designs and funding for effluent flow monitoring and a new monitoring well that was required in the draft permit. Since the permit was voluntary, the Department agreed to delay issuing final permit. In a letter dated June 21, 2007, TD&H Engineering Consultants on behalf of the RRCWSD requested that the Department finalize the permit and issue it. Based on the amount of time that lapsed between the RRCWSD request to stop and then continue the permit this statement of basis and the permit have been modified to account for the new effluent and ground water monitoring data that have been collected since the statement of basis was originally written in 2006.

The owner of the wastewater system has a requirement in their subdivision approval (EQ#03-2444) to maintain an area that is large enough for spray irrigation of the treated wastewater generated by this development in case the existing treatment system does not operate properly. This requirement was in accordance with the agreement between the original owner of the facility (Wallace Diteman) and the Department (formerly Department of Health and Environmental Sciences) on August 28, 1978. In 2003 the Department agreed to remove the requirement that land for spray irrigation be owned or leased by the wastewater system owner if the applicant voluntarily applied for and received a MGWPCS permit. However, as detailed in this statement of basis, the wastewater discharge has created exceedences of the DEQ-7 human health standard for nitrate (as N) in the ground water monitoring wells (MW-1 and MW-2) located directly downgradient of the infiltration-percolation (IP) cells (there have also been detections of fecal coliform bacteria in those wells). Because a mixing zone was not previously granted for this discharge, MW-1 and MW-2 have been the ground water compliance points for this discharge. The treatment system also has elevated biological oxygen demand (BOD) and total suspended solids (TSS) in the treated effluent. The exceedences of the human health standard in the ground water wells was a violation of the Montana Water Quality Act (75-5-605(1)(a), Montana Code Annotated) as described in a letter from the Department to the RRCWSD dated August 29, 2007. That violation letter required that the RRCWSD work with the Department to complete and issue the wastewater discharge permit. Due to the issuance of that violation letter, the MGWPCS permit was no longer a voluntary permit pursuant to the requirement of Administrative Rules of Montana (ARM) 17.30.1022(1)(c).

The RRCWSD has not maintained a lease or ownership of land for spray irrigation. Therefore, that land is no longer available for use to mitigate the impacts to the ground water from the wastewater discharge.

The wastewater treatment system received plan and specification approval from the Department on October 19, 1999 (EQ #99-2750). The system construction was completed in 1999.

The community wastewater treatment system is designed to serve 1,192 single-family homes, a school and some retail commercial businesses. The system is used to treat residential strength (domestic) wastewater.

The wastewater will be transported to the treatment system via gravity-flow and lift stations. The wastewater will receive primary treatment in two aerated lagoons in series. During the summer months, after treatment in the lagoons, the wastewater can be diverted to a third lagoon cell prior to final disposal in one of seven IP cells. During the winter months, lagoon cell #3 can be used as an additional IP cell. The design flow rate for the treatment system is 374,000 gallons per day (gpd).

The permittee has requested a standard 500-foot ground water mixing zone for nitrate and Escherichia coli (e-coli) bacteria.

III. DESCRIPTION OF DISCHARGE

A. Outfall Location

The permit authorizes the permittee to discharge treated domestic wastewater from IP cells and lagoon cell #3 (Outfall 001) to ground water.

Outfall 001 is located at 45°46’44’’ North latitude (45.7790) and 111°13’24’’ West longitude (–111.2234), which is in Section 3, Township 1 South, Range 4 East, Gallatin County.

B. Past Monitoring Data / Effluent Characteristics

1. Past Monitoring Data

The wastewater treatment system was constructed in 1999. Between 1999 and July 2008, 39 influent and effluent wastewater samples were collected for analysis. The results for some of the parameters monitored are summarized in Table 1.

Table 1. Wastewater Influent and Effluent Monitoring Data for River Rock Wastewater Treatment System

Date	Influent/ Effluent Total Nitrogen (mg/L)	Influent/ Effluent Fecal Coliform (org./100 ml))	Influent/ Effluent Biological Oxygen Demand (BOD) (mg//L))	Influent/ Effluent Total Suspended Solids (TSS) (mg/L)	Influent/ Effluent Ortho-Phosphate (mg/L)
11/18/99[1]	3.65 / 0.85	8.0E+3 / 2.0E+0	3 / 4.5	15 / 4	<0.05 / <0.05
01/05/00[1]	2.25 / NS	1.2E+3 / NS	7.5 / NS	14 / NS	0.3 / NS
02/22/00[1]	NS / 3.25	NS / 3.0E+2	NS / 10.5	NS / 18	NS / 0.6
8/24/00	51.6 / 1.2	5.0E+7 / 9.0E+0	375 / 16.5	280 / 14	8 / <0.5
10/20/00	60.4 / 1.5	2.0E+7 / 2.2E+1	270 / 18	290 / 17	5.6 / 1.46
11/22/00	41 / 0.8	4.0E+7 / 3.6E+3	285 / 13.5	15 / 4	5 / 2.2
1/5/01	47.8 / 7.9	4.0E+6 / 1.0E+1	360 / 19.5	230 / 21	9 / 2
2/27/01	43.4 / 11.8	1.0E+9 / 8.0E+1	390 / 9	210 / 32	4.5 / 1.5
5/2201	57.8 / 7.6	1.9E+6 / 5.0E+0	225 / 27	158 / 28	16 / 2.5
6/29/01	37.1 / 6.5	4.0E+4 / 2.0E+1	330 / 28.5	140 / 24	15 / 9
11/7/02	48.3 / 17.6	3.0E+7 / 4.2E+5	240 / 22.1	225 / 24	20.4 / 4.2
1/20/03	44 / 21.6	NS[3] / NS	240 / 36	220 / 26	18.5 / 13.5
8/8/03	53.4 / 12.2	7.4E+2 / 7.0	225 / 24	490 / 10	8.5 9.5

9/7/04	38.2 / 21.4	8.1E+7 / 2.0E+6	225 / 1.5	112 / 8	14.0 / 7.5
10/13/04	34.2 / 17.1	3.0E+6 / 2.3E+3	195 / 1.5	80 / 2	7.0 / 8.5
12/1/04	50.3 / 20.9	2.3E+6 / 1.8E+4	330 / 18	158 / 36	8.5 / 3.0
3/29/05	26.2 / 32.3	1.4E+6 / 5.4E+3	255 / 36	146 / 76	8.5 / 11.0
6/30/05	39.6 / 16.4	3.7E+4 / 2.7E+4	675 / 105	32 / 84	6.5 / 13.5
9/26/05	29.8 / 37.2	4.0E+4 / 4.0E+3	210 / 345	52 / 420	10.5 / 25.0
12/29/05	36.9 / 39.9	1.0E+6 / 1.0E+4	285 / 90	90 / 104	3.0 / 6.5
6/14/06	NS / NS	NS / NS	2,200 / 278	NS / NS	NS / NS
7/6/06	70.8 / 25.8	TNTC[2] / 3.0E+2	240 / 130	280 / 36	8.9 / 8.6
9/7/06	NS / NS	NS / NS	340 / 76	304 / 60	NS / NS
12/28/06	93.4 / 64.9	2.7E+6 / 1.1E+4	380 / 64	306 / 69	12.1 / 7.9
3/26/07	40.8 / 69.3	6.9E+6 / 7.0E+3	360 / 250	243 / 268	7.0 / 11.8
6/30/07	NS / NS	NS / NS	280 / 92	157 / 74	NS / NS
7/30/07	NS / NS	NS / NS	260 / 68	NS / NS	NS / NS
8/27/07	NS / NS	NS / NS	410 / 87	227 / 53	NS / NS
9/17/07	NS / NS	2.5E+7 / 1.8E+4	250 / 78	208 / 36	NS / NS
10/22/07	NS / NS	NS / NS	300 / 56	NS / NS	NS / NS
11/19/07	NS / NS	NS / NS	230 / 39	188 / 38	NS / NS
12/10/07	NS / NS	NS / NS	380 / 99	161 / 53	NS / NS
1/28/08	NS / NS	NS / NS	400 / 47	308 / 54	NS / NS
2/18/08	NS / NS	NS / NS	434 / 64	253 / 40	NS / NS
3/17/08	NS / NS	NS / NS	660 / 84	200 / 60	NS / NS
4/14/08	NS / NS	NS / NS	268 / 50	285 / 125	NS / NS
5/19/08	NS / NS	NS / NS	260 / 99	180 / 27	NS / NS
6/9/08	NS / NS	NS / NS	260 / 75	143 / 90	NS / NS
7/14/08	NS / NS	NS / NS	214 / 83	180 / 23	NS / NS

(1) Data for these dates is not representative of the typical raw wastewater or treated wastewater due to low flows into the treatment system.
(2) TNTC = to numerous to count
(3) NS = No sample analyzed

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The total nitrogen, fecal coliform bacteria, ortho-phosphate, TSS and BOD data show increasing effluent concentrations over time. These trends are likely related to the build-out of the River Rock development. As the total number of homes contributing wastewater to the treatment system increased between 1999 and 2008, the retention time in the treatment system decreased thereby increasing effluent concentrations. Since 2005, the BOD effluent concentrations would not meet the proposed effluent limits described in Section V. of this SOB. Therefore, the permit (Part 1, Section E) will include a compliance schedule for BOD reductions to below the effluent limits.

In April 2008 the RRCWSD installed a flow meter to measure the amount of wastewater being treated by the wastewater system. That flow meter has shown that the average flow is approximately 150,000 gallons per day (gpd), which is well below the system design capacity of

374,000 gpd. The population in the River Rock Development is at or near full build-out, therefore the flows to the wastewater system should not increase in the future. The flows are well below design capacity, in part, due to the use of modern low-flow fixtures, which weren't accounted for in the original design of the system in the 1970's.

2. Effluent Characteristics

Using discharge monitoring data from three other wastewater treatment systems (the towns of Superior, Gardiner and Belt) that use similar treatment technology as used at the River Rock facility, the average and 90th percentile effluent concentrations for total nitrogen, BOD, TSS, and total phosphorus produced by those facilities over the past three years (2002 through 2004) are listed in Table 2.

Table 2. Wastewater Effluent Statistics for Similar Wastewater Treatment Facilities (2002-2004)

Facility	Total Nitrogen (mg/L)	Biological Oxygen Demand (mg/L)	Total Suspended Solids (mg/L)	Total Phosphorus (mg/L)
GARDINER				
Average	21.0	15.4	22.1	4.1
90th Percentile	28	26.4	58.8	5.4
SUPERIOR				
Average	22.8	18.6	20.3	5.8
90th Percentile	34.1	31.8	53	5.3
BELT				
Average	10.0[1]	16.0	25.3	2.4[1]
90th Percentile	15.9[1]	28.4	46.2	2.9[1]

(1) These values based only on one year of data (2002).

The results indicate that system produces similar effluent quality, except for the nutrients in the Belt effluent. The total nitrogen and total phosphorus effluent concentrations are noticeably lower in the Belt wastewater than the other two facilities. Whether this difference is due to better treatment efficiencies or different influent wastewater characteristics cannot be determined from the existing data.

The 90th percentile statistic is included in Table 2 to demonstrate the type of effluent concentrations that can be expected on a regular basis for these types of treatment systems.

IV. RECEIVING WATER

A. Water Use Classifications and Applicable Water Quality Standards

The facility has been collecting background ground water quality data from a monitoring well located in the southwest corner of the river rock development (MW-3). MW-3 was constructed as a background ground water quality monitoring point for comparison to two wells (MW-1 and MW-2) that are located north (downgradient) of the wastewater treatment facility (see Attachment 2A and 2B). Between March 1999 and June 2008, ground water from MW-1, MW-2 and MW-3 were collected and analyzed for several water quality parameters on 35 different dates (see Attachment 3). In February 2008, the RRWCSD installed an additional ground water monitoring well, MW-4. MW-4 is a new background monitoring well that is located immediately upgradient of the IP cells (see Attachment 2A). This new well was installed to better determine the ground water quality prior to the discharge from the IP cells. The existing background well, MW-3, was located far enough upgradient that its water quality may be different than the ground water flowing beneath the IP cells.

The IP cells are constructed on top of quaternary alluvial deposits of the Gallatin valley. Based on two monitoring wells (MW-1 and MW-2) constructed along the north end of the lagoon cells and IP beds, the soils consist of sandy gravels and gravelly sands down to the water table at 50 to 56 feet below ground surface (see Attachment 2A).

Based on the 35 water quality analyses from MW-3, the average nitrate+nitrite (as N) of the upgradient ground water is 3.54 mg/L. However, prior to May 2002, the highest nitrate+nitrite (as N) concentration in MW-3 did not exceed 3.7 mg/L and the average of those first ten samples was only 1.77 mg/L. Since May 2002, the average nitrate+nitrite (as N) concentration from 25 sampling events has been 4.30 mg/L, and has been as high as 7.0 mg/L. The cause of the increase is not certain, but may be related to historic manure storage/distribution practices or agricultural practices on the land located to the south (upgradient) from MW-3. The chloride concentration in MW-3 has not risen concurrently with the nitrate+nitrite concentrations (the chloride concentrations have remained below 18 mg/L), which indicates the nitrate+nitrite increase is likely not due to human-derived wastewater. Domestic wastewater typically includes elevated concentrations of chloride that are not typically present in agriculturally-related sources or in manure sources.

Two samples collected in 2008 from the new background monitoring well, MW-4, show nitrate (3.16 and 4.12 mg/L) and chloride (5.45 and 7.46 mg/L) at similar concentrations as in MW-3.

The nitrate+nitrite concentrations in the two monitoring wells (MW-1 and MW-2) directly north of the wastewater system have also shown increases. Those two monitoring wells have exceeded the nitrate+nitrite (as N) DEQ-7 human health standard of 10 mg/L on fourteen dates, with a maximum concentration of 49 mg/L in MW-2 (see Attachment 3). MW-1 and MW-2 have also shown concurrent increases in their chloride concentrations (from less than 10 mg/L to as high as 85 mg/L), which is an indication that the increasing nitrate+nitrite concentrations in MW-1 and MW-2 are likely related to the River Rock wastewater discharge. The low chloride concentrations in MW-3 and MW-4 also support the conclusion that the elevated nitrate concentrations in MW-1 and MW-2 are primarily due to the wastewater discharge from the RRCWSD IP cells.

MW-1 and MW-2 have also had fecal coliform bacteria detections on fifteen dates (see Attachment 3).

Due to exceedences of the nitrate water quality standard in the ground water, the permit (Part I, Section E) will include a compliance schedule for reducing nitrate below the water quality standard at the end of the mixing zone (MW-1 and MW-2). In addition, because it is anticipated that the e-coli bacteria water quality standard will be exceeded when monitoring begins, the permit will also include a compliance schedule for reducing e-coli bacteria below the water quality standard in MW-1 and MW-2. It is anticipated that e-coli will exceed the water quality standard in the ground water because of past detections of fecal coliform bacteria in MW-1 and MW-2. Fecal coliform bacteria was the pathogenic standard in DEQ-7 prior to February 2006 and therefore was the required monitoring parameter in MW-1 and MW-2. Since February 2006 e-coli bacteria has been the pathogen standard in DEQ-7.

A nitrate+nitrite (as N) concentration of 10.0 mg/L was recorded in MW-2 in September 2003. According to the Certificate of Subdivision Plat Approval for River Rock (EQ#99-2750), an increase of the nitrate+nitrite(as N) concentration in MW–1 or MW-2 above 7.5 mg/L requires the monitoring frequency for MW-1 and MW-2 to be increased from semi-annually to quarterly. However, in violation of the certificate of subdivision plat approval, no samples were collected or analyzed from MW-1 or MW-2 between December 2003 and September 2004. The RRWCSD was not issued a violation letter for that, but were requested to increase the monitoring frequency to quarterly (see Attachment 3).

In 2007 and 2008 the Gallatin County Local Water Quality District monitored the ground water quality of 71 wells in the vicinity of the River Rock wastewater discharge. This study concentrated many of those wells in the area downgradient of the River Rock IP cells. The data shows some elevated nitrate and chloride concentrations in domestic wells located downgradient (northerly) from the IP cells. Some of the wells also contained coliform bacteria. However, none of the wells included in the study exceeded DEQ-7 water quality standards for nitrate or e-coli bacteria. The domestic well located closest to the IP cells (located at 34 Wildhorse Trail) had reported a nitrate concentration on August 12, 2007 of 21.2 mg/L from a sample collected by the homeowner.

Based on the 23 water quality analyses from MW-3 from 1999 through 2007, the average specific conductivity of the ground water is 450 umhos/cm. Therefore, the classification of the receiving ground water is Class I.

The receiving water for Outfall 001 is Class I ground water as defined by the Administrative Rules of Montana [ARM 17.30.1006 (1)(a)]. Class I ground water is suitable for the following beneficial uses with little or no treatment: public and private water supplies, culinary and food processing purposes, irrigation, drinking water for livestock and wildlife and for industrial and commercial uses. Secondary and human health standards (DEQ-7, February 2008) apply to concentrations of substances in Class I ground waters (water with specific conductance equal to or less than 1,000 microSiemens/cm). Class I ground waters are considered high quality waters and are subject to Montana's Nondegradation Policy [75-5-303, Montana Code Annotated (MCA)]. The applicable water quality standards are shown in Table 3.

Because this wastewater discharge was originally approved by the state prior to April 29, 1993, it is not considered a new or increased source pursuant to ARM 17.30.702(18). Therefore, the nondegradation limits do not apply to this discharge, but the DEQ-7 water quality standards do apply.

Table 3. Applicable Water Quality Standards

Parameter	DEQ-7 Numeric Human Health Ground Water Standards
Nitrate (as N), mg/L	10(1)
Total Phosphorus, mg/L	No numeric standard
E-coli Bacteria, organisms/100 ml	<1(2)

(1) Instantaneous maximum, no single sample shall exceed this value, DEQ-7 (February, 2006).
(2) Maximum based on 24-hour geometric mean, DEQ-7 (February, 2006).

The nearest downgradient surface water from the outfall is Ben Hart Creek. In the direction of ground water flow (N29^{o}E) Ben Hart Creek is approximately 25,400 feet from the northeast corner of the IP cells. Ben Hart Creek is classified as a B-2 surface water [ARM 17.30.610(1)].

B. Mixing Zone

The RRCWSD has proposed to discharge all wastewater from Outfall 001 and has requested a standard ground water mixing zone for nitrate and e-coli bacteria of 500 feet. The RRCWSD has also requested that the width of the mixing zone be increased for the cold weather season (from a width of 470 feet to a width of 660 feet in the cold weather season). The "cold weather mixing zone" is wider and accounts for discharges from lagoon cell #3 that may be used as an IP bed during the cold months. At the time the treatment system was originally designed and approved by the Department (1970's), storage cells did not have maximum allowable leakage rates, therefore lagoon cell #3 can be used as a discharge location and can also be used as a storage cell when the inflow to the cell #3 exceeds the discharge rate. Due to the difficulty in assigning multiple effluent limits over a 90-day averaging period depending on whether lagoon cell #3 is used as an IP bed or not and for how long over that 90-day period it is used, it is not feasible to assign multiple effluent limits or designate different mixing zone dimensions for different seasons. Therefore, the granted mixing zone will be based on the wider cold weather discharge. To insure there are no exceedences of water quality standards at the end of the mixing zone, the more conservative scenario between warm-weather discharges (when cell #3 is not used for discharge of treated wastewater) and cold-weather discharges (when cell #3 may be used for discharge of treated wastewater) will be used in determining water quality-based effluent limits.

From October 2000 through June 2007 the permittee conducted 19 rounds of effluent monitoring for chloride and TN and concurrent monitoring of MW-1 and MW-2 (the data from MW-1 was not used in the following analysis because it did not show as consistent or long-term water quality impacts as were observed in MW-2). This monitoring was conducted to determine the amount of natural denitrification (reduction of nitrate to nitrogen gas) that is occurring beneath the IP beds. The amount of natural denitrification beneath the IP beds can then be used in calculating the water quality-based effluent limits (WQBEL). Chloride is considered a conservative element (i.e. it does not degrade in the environment). Therefore, the percent reduction of the chloride concentration between the discharge point and MW-2 can be solely attributed to ground water dilution. If the amount of chloride dilution is compared to the concentration reduction of TN between the discharge point and MW-2, any additional percent reduction of TN (as compared to the percent reduction of chloride) can be reasonably attributed to denitrification. Based on this method, the water quality information indicated that denitrification accounted for a 50% concentration reduction of TN between the effluent monitoring point and MW-2. That 50% reduction will be accounted for in determination of the TN WQBEL (see Part V.D. of this SOB).

The permittee must comply with the ground water mixing zone rules pursuant to ARM 17.30 Subchapter 5. Due to existing domestic drinking water wells that are located approximately 500 feet downgradient of the IP cells, the mixing zone cannot extend the standard length of 500 feet. Pursuant to ARM 17.30.508(2) a mixing zone may not extend into the zone of influence of an existing drinking water supply well. The zone of influence for a domestic well is commonly assumed to be a 100 foot radius around the well. Therefore, the Department can grant a source specific mixing zone that extends to a point that is 100 feet upgradient of any existing drinking water supply well. Based on the approximate location of the existing downgradient wells, the mixing zone could be set at approximately 400 feet long. However, the RRCWSD does not own the property where the mixing zone could extend to and cannot gain access to that property for the purpose of installing compliance monitoring wells. Therefore, the mixing zone length will be based on the point where the RRCWSD can monitor the impacts in the ground water. That length is currently defined by the existing monitoring wells MW-1 and MW-2, which are approximately 50 feet downgradient from the northern end of the IP cells (see Attachment 4).

The mixing zone will extend downgradient of the IP cells and lagoon cell #3 in a N29^{o}E direction (parallel to the local ground water gradient) and end at the northern boundary of the RRCWSD property where MW-1 and MW-2 are located. The hydraulic gradient is based on an average of eleven quarterly water level monitoring events on wells MW-1, MW-2 and MW-3 between June 2000 and January 2003. The shape of the mixing zone is determined from the dimensions of the IP beds/lagoon cell #3 and the measured ground water flow direction. Water level data collected off-site by the Gallatin County Local Water Quality Protection District in 2007 and 2008 indicates that the ground water flow direction eventually curves to the north and northwest downgradient of the RRCWSD IP cells.

The ground water mixing zone is granted for nitrate and for e-coli bacteria.

V. PROPOSED WATER QUALITY-BASED EFFLUENT LIMITS

The permittee must comply with the Numeric Water Quality Standards included in Circular DEQ-7 (February 2008) and protection of beneficial uses [ARM 17.30.1006]. Ground water quality standards may be exceeded within a Department authorized mixing zone provided that all existing and future beneficial uses of the state waters are protected [ARM 17.30.1005]. In addition, for parameters that do not have human health standards in DEQ-7 (February 2008), the discharge may not cause an increase of a parameter to a level that renders the waters harmful, detrimental or injurious to the beneficial uses listed for Class I ground water [ARM 17.30.1006(1)(c)(ii)].

The Montana Water Quality Act requires that a discharge to state water shall not cause a violation of a water quality standard outside a Department authorized mixing zone. Ground water quality standards for nitrate (as N) apply at the down-gradient mixing zone boundary in the unconfined aquifer. Water quality standards for other parameters that have not been granted a mixing zone apply below the discharge area. The WQBELs have been determined as follows:

A. BOD_5

Effluent monitoring and WQBELs for five-day biological oxygen demand (BOD_5) will be required to maintain USEPA primary and secondary drinking water limits and DEQ-7 human health standards in the ground water downgradient from the discharge.

As BOD is discharged to ground water, the BOD in the wastewater will decrease the dissolved oxygen (DO) concentration in the ground water. As the DO concentration in the ground water decreases the potential for odor problems in the ground water and leaching of metals from the soils and rock increases (USEPA, 2002). The USEPA has secondary drinking water limits (40 CFR 143.3) for odor. The regulatory limits for metals are in USEPA primary drinking water limits (40 CFR 141.62) and in DEQ-7 human health standards. To prevent potential exceedences of these ground water limits, the permit will require monitoring and effluent limits for BOD in the wastewater discharge.

Because BOD does not have drinking water or ground water concentration limits, the narrative water quality standards [ARM 17.30.1006(1)(b)(ii)] for class I ground waters will be used to determine the effluent limits to protect ground water quality. Those narrative standards allow the Department to use any pertinent credible information to determine the appropriate levels of effluent discharge to maintain water quality in the receiving water. Because there are no water quality based limits for discharges of BOD to ground water, the permit will use the technology based effluent limits that have been adopted for discharges to surface water. The Board of Environmental Review (BER) has adopted technology-based effluent limits for BOD from the national secondary treatment standards [40 CFR 133.102(a)] for surface water discharges. Those national secondary treatment standards will be used in the permit in lieu of any other applicable limits to ensure protection of the ground water quality.

Note that the 23 BOD effluent concentrations measured from June 2005 through July 2008 would have been above these proposed effluent limits.

B. TSS

There are no narrative or numerical standards for TSS discharges to ground water. Therefore, there is no WQBEL for TSS for Outfall 001. The permit will require monitoring for TSS for determining proper operation of the wastewater system.

C. pH

Effluent monitoring and WQBELs for pH will be required to maintain USEPA secondary drinking water standards (6.5 – 8.5) in the ground water and to protect the quality of the class I groundwater pursuant to ARM 17.30.1006(1)(b)(ii). The national secondary treatment standards [40 CFR 133.102(c)] will be used in the permit in lieu of any other applicable limits to ensure protection of the ground water quality.

The effluent limits for pH in Table 4.

D. Nitrate

The TN concentration in the I/P cell effluent is estimated to determine whether the applicable ground water quality standard (10 mg/L) can be met at the end of the mixing zone (nondegradation limits are not applicable as discussed in Part IV. A. of this SOB). A sensitivity analysis estimates the ground water nitrate+nitrite (as N) concentration at the end of the mixing zone that would result from the discharge. This estimate is derived from a dilution calculation utilizing the following mass balance equation:

$$C_2 = \frac{C_3(Q_1 + Q_2) - C_1 Q_1}{Q_2} \qquad \textit{(eqn. 1)}$$

where:
- C_1 = Ambient (background) ground water nitrate+nitrite (as N) concentration (mg/L).
- C_2 = Allowable nitrate (as N) discharge concentration (mg/L).
- C_3 = Ground water concentration limit for nitrate (as N) [from Circular DEQ-7 or other appropriate water quality standard] at the end of the mixing zone
- Q_1 = Ground water volume mixing with the discharge (ft^3/day).
- Q_2 = Design discharge volume (ft^3/day).

As discussed in Part IV. A., the average background ground water nitrate+nitrite (as N) concentration (C_1 in equation 1) in MW-3 has been 4.30 mg/L since May 2002. The nitrate+nitrite concentrations were significantly lower during the two years prior to May 2002.

However, because the nitrate+nitrite concentrations in MW-3 have been typically elevated since May 2002, the background concentration used for determining the WQBEL will be based on those values.

The allowable nitrate concentration (C_3 in equation 1) at the end of the ground water mixing zone is 10 mg/L (DEQ-7 water quality standard).

The design flow (Q_2 in equation 1) is 374,000 gpd (50,000 ft^3/day).

The volume of ground water that will mix with the discharge (Q_1 in equation 1) is estimated using Darcy's equation:

$$Q_1 = K\ I\ A \qquad \textit{(eqn. 2)}$$

Where:
Q_1 = ground water flow volume (ft^3/day)
K = hydraulic conductivity (ft/day)
I = hydraulic gradient (ft/ft)
A = cross-sectional area of flow at the down-gradient boundary of the 50-foot mixing zone (ft^2).

Two Q_1 values need to be calculated for the warm-weather and cold-weather mixing zones. For the warm-weather mixing zone (470 feet wide at the source), Q_1 is:

$$Q_1 = (600\text{ ft/day})(0.0079\text{ ft/ft})(7{,}181\text{ ft}^2)$$
$$Q_{1(warm)} = 34{,}038\text{ ft}^3\text{/day}$$

For the cold-weather mixing zone (660 feet wide at the source), Q_1 is:

$$Q_1 = (600\text{ ft/day})(0.0079\text{ ft/ft})(10{,}031\text{ ft}^2)$$
$$Q_{1(cold)} = 47{,}547\text{ ft}^3\text{/day}$$

Hydraulic conductivity of the shallow ground water (600 feet/day) is based on a summary of previous aquifer tests performed in this general area (Custer, 1994). Three of those aquifer tests were included in a U.S. Geological Survey report (Hackett, et. al., 1960). Additional aquifer tests were not performed on the onsite wells since the existing data was sufficient to estimate the aquifer characteristics.

As discussed in Part IV. B., the hydraulic gradient is based on an average of eleven quarterly water level monitoring events on wells MW-1, MW-2 and MW-3 between June 2000 and January 2003. The gradient is 0.0079 ft/ft at a direction of N29^{o}E.

The area (A) is calculated by the width at the end of the mixing zone times a standard depth in the groundwater of 15 feet. It is assumed that the entire TN load in the effluent converts to nitrate and enters the ground water.

The effluent concentration necessary to maintain the nitrate concentration at the end of the warm-weather mixing zone at less than 10 mg/L is calculated below using equation 1:

$$C_{2(warm)} = \frac{10 \text{ mg/L } (34{,}038 \text{ ft}^3\text{/d} + 50{,}000 \text{ ft}^3\text{/d}) - [(4.30 \text{ mg/L})(34{,}038 \text{ ft}^3\text{/d})]}{(50{,}000 \text{ ft}^3\text{/day})}$$

$$C_{2(warm)} = 13.9 \text{ mg/L}$$

The effluent concentration necessary to maintain the nitrate concentration at the end of the cold-weather mixing zone at less than 10 mg/L is calculated below using equation 1:

$$C_{2(cold)} = \frac{10 \text{ mg/L } (47{,}547 \text{ ft}^3\text{/d} + 50{,}000 \text{ ft}^3\text{/d}) - [(4.30 \text{ mg/L})(47{,}547 \text{ ft}^3\text{/d})]}{(50{,}000 \text{ ft}^3\text{/day})}$$

$$C_{2(cold)} = 15.4 \text{ mg/L}$$

The more restrictive value of the two calculations (the warm-weather mixing zone) will be used to calculate the effluent limit. Therefore, at the design capacity of 374,000 gpd, the maximum concentration of TN discharged to ground water must not exceed 13.9 mg/L at outfall 001. This effluent limit ensures the nitrate (as N) concentration at the end of the ground water mixing zone will remain at or below the water quality standard of 10 mg/L. As discussed in Part V.B., there is approximately a 50% reduction of TN (due to denitrification) beneath the IP beds. Therefore, to discharge a TN concentration of 13.9 mg/L to the ground water, the WQBEL for outfall 001 is 27.8 mg/L. Using this concentration, and a design flow of 374,000 gpd, provides a TN load limit of 86.7 lbs/day, which will be the WQBEL for outfall 001. Because the mass balance calculation used to determine the WQBEL is based on the total load of nitrogen (which is a factor of the concentration and volume of wastewater) entering the ground water, the WQBEL will be based on the 30-day average load, not on a concentration limit.

E. <u>E-coli Bacteria</u>

E-coli bacteria monitoring in the ground water is included in this permit because:

- the shallow aquifer is a coarse grained alluvial aquifer with a high hydraulic conductivity (600 ft/day), which will allow relatively rapid transport of e-coli bacteria if any are able to migrate into the groundwater;
- the IP beds are designed to discharge a significant amount of wastewater (374,000 gpd) at a relatively rapid rate; and
- this area is experiencing rapid high density development
- The existing influent/effluent data shows that the treatment system does not remove all of the fecal coliform bacteria; and
- The existing ground water monitoring data in MW-1 and MW-2 indicates fecal coliform bacteria contamination.

A virus transport study conducted in western Montana revealed a four log decrease of pathogens when discharged directly into the ground water but the results are site specific and are dependent on the amount of fine soil present at the site (Woessner, 1998).

The permit will require ground water monitoring at MW-1 and MW-2 to insure that the DEQ-7 (February 2008) water quality standard (<1 e-coli bacteria/100 ml) is not exceeded.

F. Phosphorus

Phosphorus does not have a numeric ground water quality standard, and the nondegradation limits do not apply to this discharge. Therefore, there is no WQBEL for phosphorus for Outfall 001.

The WQBELs for Outfall 001 are summarized in Table 4.

Table 4. Water Quality-Based Effluent Limits for Outfall 001

Parameter	**Concentration (1) (mg/l)**		**Load (lb/ day)**	**Rationale**
	7-Day Average	**30-Day Average**	**30-Day Average(2)**	
BOD5	45	30	93.6	ARM 17.30.1006(1)(b)(ii)
Total Nitrogen as N(3)	NA	NA	86.7	ARM 17.30.1006(1)(b)(i)
pH, s.u.	6.0 – 9.0			ARM 17.30.1006(1)(b)(ii)

(1) See the definitions in Part VI. of the permit for explanation of terms.
(2) Calculations based on the 30-day average values of flow and concentration
(3) Total Nitrogen (TN) is the sum of nitrate, nitrite, and total kjeldahl nitrogen (as N).
NA Not Applicable

Calculations for the mass-based loadings utilized the following equation:

(lbs/day) = Design flow (mgd) x Average Concentration (mg/l) x 8.34 factor

BOD_5 (lb/day) = (0.374)(30.0)(8.34) = 93.6 lb/day (30-day)

VI. FINAL PROPOSED EFFLUENT LIMITS

The proposed effluent limitations, which are all based on WQBELs, for Outfall 001 are summarized in Table 5.

Table 5. Numeric Effluent Limits for Outfall 001

Parameter	Concentration [1] (mg/l)			Load[1] (lb/ day)
	7-Day Average	30-Day Average	Daily Maximum	30-Day Average[2]
BOD_5	45	30	NA	93.6
pH, s.u.	6.0 – 9.0			
Effluent Flow Rate, gpd	374,000 maximum flow			
Total Nitrogen as N[3]	NA	NA	NA	86.7

(1) See definitions in Part VI. of the permit.
(2) Calculations based on the average values of design flow and concentration for the specified time period. Equation is Load (lb/d) = flow (gpd) x concentration (mg/L) x 8.34×10^{-6}.
(3) Total Nitrogen (TN) is the sum of nitrate, nitrite and total kjeldahl nitrogen (as N).
NA Not Applicable

VII. MONITORING REQUIREMENTS

A. Effluent Monitoring

Effluent monitoring is essential to ensure the effective treatment of the wastewater discharged from the facility. The effluent limits are established to protect the ground water from a change in water quality that would exceed a water quality standard [ARM 17.30.1006(1)(b)(i)] or cause a change in beneficial use [ARM 17.30.1006(1)(b)(ii)].

At a minimum, upon the effective date of the permit, the constituents in Table 6 shall be monitored at the frequency and with the type of measurement indicated. Samples or measurements shall be representative of the volume and nature of the monitored discharge. The flow monitoring device is an ultrasonic echo ranging type open channel flow meter (weir-type) manufactured by Greyline Instruments, as approved by the Department on September 19, 2007.

The effluent sampling location shall be from the discharge manhole near the exit from lagoon cell 2 at location "C2" (see Attachment 2B) prior to discharge to lagoon cell #3 and/or the IP beds. Location C2 is the last point of control in the treatment process.

The reporting period for the constituents in Table 6 is monthly.

Table 6. Parameters Monitored in the Effluent for Outfall 001 (prior to discharge to lagoon cell #3 and/or IP beds)

Parameter[1]	Frequency	Sample Type[2]
Effluent Flow Rate, gpd[3]	Continuous	Continuous
pH, s.u.	Monthly	Grab
Total Suspended Solids (TSS), mg/L	Monthly	Composite
Biological Oxygen Demand (BOD_5), mg/L	Monthly	Composite
Chloride, mg/L	Monthly	Composite

E-coli Bacteria, organisms/100 ml	Monthly	Grab
Total Phosphorus as P(4), mg/L	Monthly	Composite
Nitrate as N, mg/L	Monthly	Composite
Nitrite as N, mg/L	Monthly	Composite
Ammonia as N, mg/L	Monthly	Composite
Total Kjeldahl Nitrogen as N, mg/L	Monthly	Composite
Total Nitrogen(5), mg/L	Monthly	Calculated
Total Phosphorus, lb/day(6)	Monthly	Calculated
Total Nitrogen, lb/day(6)	Monthly	Calculated
Oil & Grease, mg/L	Semi-annually	Composite
Total Phenols, mg/L	Semi-annually	Composite
Arsenic, dissolved, mg/L	Semi-annually	Composite
Cadmium, dissolved, mg/L	Semi-annually	Composite
Chromium, dissolved, mg/L	Semi-annually	Composite
Copper, dissolved, mg/L	Semi-annually	Composite
Lead, dissolved, mg/L	Semi-annually	Composite
Mercury, dissolved, mg/L	Semi-annually	Composite
Selenium, dissolved, mg/L	Semi-annually	Composite
Silver, dissolved, mg/L	Semi-annually	Composite
Zinc, dissolved, mg/L	Semi-annually	Composite

(1) Laboratory detection limits must be equal to or less than the required reporting value (RRV) in DEQ-7 (February, 2006) for those parameters where an RRV is specified in DEQ-7.
(2) See definitions in Part VI. of the permit
(3) To be measured by a recorder or totalizing flow meter
(4) EPA Method 365.1 or equivalent.
(5) Total Nitrogen (TN) is the sum of nitrate, nitrite and total kjeldahl nitrogen as N.
(6) See definition of "monthly average" in Part VI. of the permit. The calculation used for determining load is: Load (lb/d) = flow (gpd) x concentration (mg/L) x $8.34x10^{-6}$.

B. <u>Ground Water Monitoring and Compliance Limits</u>

Ground water monitoring is required in this permit due to the following site-specific conditions:

- the shallow aquifer is a coarse grained alluvial aquifer with a high hydraulic conductivity (600 ft/day), which will allow relatively rapid transport of contaminants that are able to migrate into the groundwater;
- the IP beds are designed to discharge a significant amount of wastewater (374,000 gpd) at a relatively rapid rate;
- this area is experiencing rapid high density development
- The existing influent/effluent data shows that the treatment system does not remove all of the fecal coliform bacteria; and
- The existing ground water monitoring data in MW-1 and MW-2 indicates fecal coliform bacteria and nitrate contamination.

The permittee is required to monitor the ground water on the downgradient edge of the IP beds from existing monitoring wells, MW-1 and MW-2 (see Attachment 4). In addition to the downgradient monitoring wells, MW-1 and MW-2, the permit will require monitoring of the new upgradient background monitoring well, MW-4, to supplement the existing upgradient well, MW-3. The location of all the wells are shown on Attachment 2A. Monitoring results from MW-4 will be used for comparison with results from MW-1, MW-2 and MW-3, to help determine potential causes of ground water quality fluctuations.

The parameters to be monitored in MW-1, MW-2, MW-3 and MW-4 are listed in Table 7. The reporting period for the constituents in Table 7 is monthly.

Table 7. Ground Water Monitoring Parameters for Monitoring Wells MW-1, MW-2, MW-3 and MW-4

Parameter	Frequency	Sample Type(1)
Static Water Level (SWL) (feet below top of casing)	Monthly	Instantaneous
E-coli Bacteria, organisms/100 ml	Monthly	Grab
Nitrate as N, mg/L	Monthly	Grab
Ammonia as N, mg/L	Monthly	Grab
Chloride, mg/L	Monthly	Grab

(1) See definitions, Part VI. of the permit.

The monitoring of chloride is used as an indicator of wastewater impacts, and will be used to assess the effectiveness of the well location in monitoring ground water impacts when the permit is renewed.

MW-1 and MW-2 are located at the end of the mixing zone for Outfall 001 (see Attachment 4). MW-1 and MW-2 will be used as the ground water compliance monitoring locations. The ground water compliance limits for MW-1 and MW-2 are listed in Table 8.

Table 8. Ground Water Compliance Limits for Monitoring Wells MW-1 and MW-2

Parameter	Instantaneous Maximum[1]
E-coli Bacteria, organisms/100 ml	Less than 1
Nitrate as N, mg/L	10

1. See definitions, Part VI. of the permit.

C. Compliance Schedules

If any single monitoring result from MW-1 or MW-2 demonstrates that the ground water quality standard for e-coli bacteria or nitrate (as N) in the receiving ground water are exceeded the following compliance schedule will be implemented.

- NITROGEN
  If any single monitoring result from MW-1 or MW-2 exceeds the ground water compliance limit for nitrate (as N) in Table 8 the permittee will be required to comply with the following compliance schedule to meet the nitrate (as N) compliance limit in this permit:
  - Within 24 months of the compliance limit exceedence, prepare plans and specifications for modifications designed to reduce the nitrate (as N) to below the ground water compliance limits, and secure funding for those improvements.
  - Within 36 months of compliance limit excceedence have plans and specifications for those modifications reviewed and approved by the Water Protection Bureau.
  - Within 48 months of compliance limit exceedence have all of the modifications installed and fully operational.

- ESCHERICHIA COLIFORM (E-COLI) BACTERIA
  If any single monitoring result from MW-1 or MW-2 exceeds the ground water compliance limit for Escherichia coliform (e-coli) bacteria in Table 8 the permittee will be required to comply with the following compliance schedule to meet the e-coli compliance limit in this permit:
  - Within 24 months of the compliance limit exceedence, prepare plans and specifications for modifications designed to reduce the e-coli bacteria to below the ground water compliance limits, and secure funding for those improvements.
  - Within 36 months of compliance limit excceedence have plans and specifications for those modifications reviewed and approved by the Water Protection Bureau.
  - Within 48 months of compliance limit exceedence have all of the modifications installed and fully operational

Due to the history of consistent exceedences of the BOD effluent limits in the permit the following compliance schedule applies to this facility. This compliance schedule is in place to protect the quality of the ground water beneath and downgradient of the wastewater discharge.

- BOD
  Based on existing effluent data, the wastewater treatment system in its current configuration consistently exceeds the BOD effluent limits in Table 5. Therefore, upon the effective date of the permit the permittee will be required to comply with the following compliance schedule to meet the BOD effluent limits in this permit:
  - Within 24 months of the effective date of the permit, prepare plans and specifications for modifications designed to reduce the BOD to below the permit effluent limits, and secure funding for those improvements.
  - Within 36 months of the effective date of the permit have plans and specifications for those modifications reviewed and approved by the Water Protection Bureau.

- Within 48 months of the effective date of the permit have all of the modifications installed and fully operational.

VIII. NONDEGRADATION SIGNIFICANCE DETERMINATION

The Department has determined that this discharge does not constitute a new source for the purpose of the Montana Nondegradation Policy [75-5-303, MCA; ARM 17.30.702(18)] because this facility was originally approved by the Department prior to April 29, 1993.

IX. INFORMATION SOURCES

ARM Title 17, Chapter 30, Sub-chapter 5 - Mixing Zones in Surface and Ground Water.

ARM Title 17, Chapter 30, Sub-chapter 10 - Montana Ground Water Pollution Control System (MGWPCS) Standards

ARM Title 17, Chapter 30, Sub-chapter 7 - Nondegradation of Water Quality.

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Custer, S.G.. 1994. Hydrology for the Belgrade Waste Water Facility Plan, 23 pp.

Hackett, O.M., Visher, F.N., McMurtrey, R.G. and Steinhulber, W.W., 1960. Geology and Ground-Water Resources of the Gallatin Valley, Gallatin County, Montana. U.S. Geological Survey Water Supply Paper 1482, 282 p.

Harkin, John M., Charles J. Fitzgerald, Colin P. Duffy, and David G. Kroll. 1979. Evaluation of Mound Systems for Purification of Septic Tank Effluent. University of Wisconsin, Madison. Tech. Report WIS WRC 79-05.

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USEPA, Manual: Guidelines for Water Reuse, EPA/625/R-92/004, September 1992.

USEPA, Onsite Wastewater Treatment Systems Manual, February 2002.

Woessner, Wm. W., Thomas, Troy, Ball, Pat and DeBorde, Dan C., (April 1998), Virus Transport in the Capture Zone of a Well Penetrating a High Hydraulic Conductivity

Aquifer Containing a Preferential Flow Zone: Challenges to Natural Disinfection. University of Montana, Missoula, Montana.

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